Barrier Coatings and Stability of Thin Film Solar Cells

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Subcontractor: **Pacific Northwest National Laboratory**

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1. OBJECTIVES/APPROACH

The key objectives of the program are to develop low cost barrier coatings for CIS and CdTe solar cells and to develop an improved understanding of the effects of water on the stability of these types of cells. The scope of this work entails investigations of multilayer, barrier coatings for CIS and CdTe thin film solar cells, and studies of stability issues, particularly those related to moisture ingress. Investigation of barrier coatings on SSI and CSU devices will continue in an effort to establish effective approaches to encapsulate CIS and CdTe modules. Studies will also be directed towards issues concerning cost of the coating process. The program will be structured into three major tasks: (1) Barrier coatings and stability studies for CIS Solar Cells; (2) Barrier coatings and stability studies for CdTe solar cells; (3) Low cost coating process development.

2. PROGRESS FOR THIS REPORTING PERIOD

No substrates with CdTe cell structures were received this quarter from CSU or UT. As a result, studies of photoluminescence in CdTe solar cell structures were initiated. The objective of this effort is to determine if the PL spectrum for a CdTe device is affected by stress. In particular, we are interested in determining if moisture affects carrier properties.

Samples studied were cell structures without back contacts provided a year ago by CSU. The approach to the PL studies is described in Figure 1. An excitation wavelength of 580 nm was used and band gap emission observed for the excitation beam entering the through the glass and through the CdTe side. The emission spectra are shown in Figure 2. Note that the effective lifetime is largest for the case of the excitation photons incident through glass.

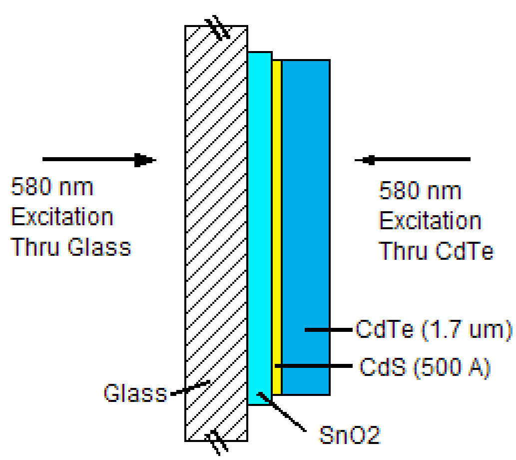

Figure 1. Sample configuration used for photoluminescence studies.

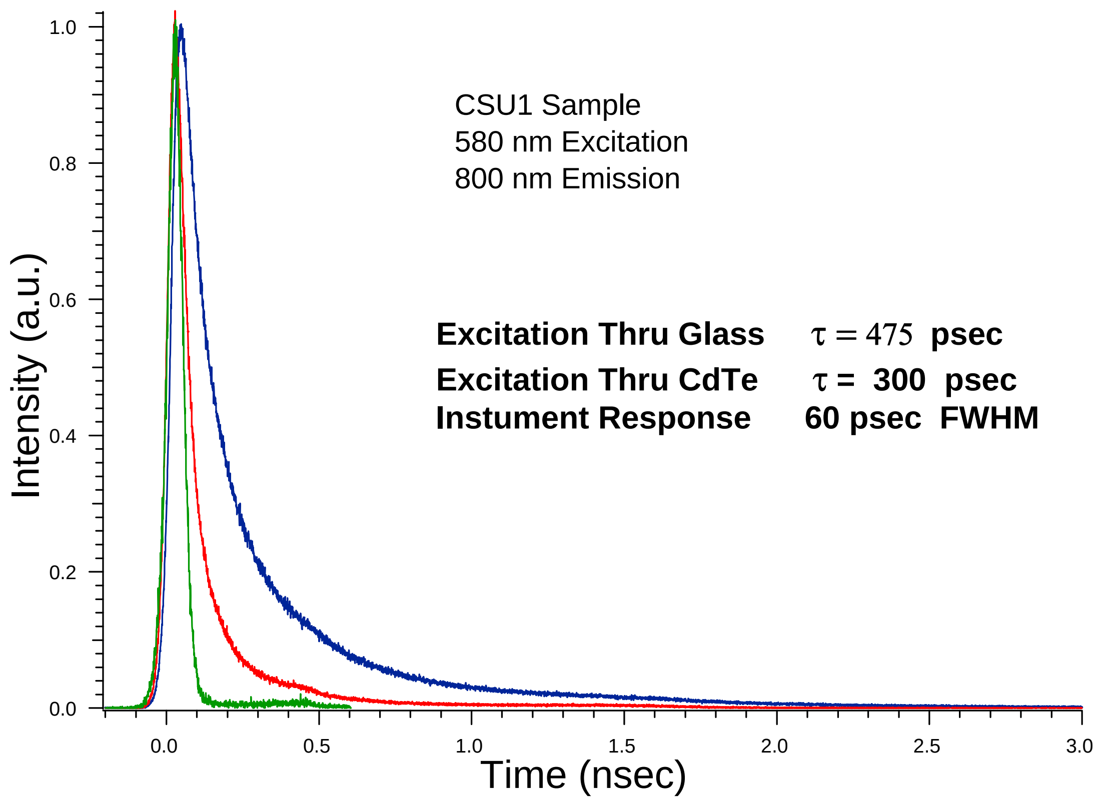

Figure 2. Photoluminescence spectra for CSU CdTe cell structures.

As indicated by Figure 2, the effective lifetime for electrons is greater in the case of the 580 nm photons entering the structure form the glass side, which is the junction side of the CdS/CdTe cell structure. Although the CSU cells are fully depleted, the field should be larger near the CdS-CdTe interface. It appears, therefore, that conduction electrons created in the higher field region exhibit a larger lifetime than those created nearer the back face of the cell. This result is consistent with Hovel's derivation for the effective diffusion length of a minority carrier in the region of an electric field. An electron band diagram is shown in Figure 3 to amplify on these points.

3. FUTURE WORK

The CSU cell that was characterized by PL is now being subjected to 60ºC/90RH. After several hundred hours, the PL spectrum will be taken again in an effort to determine if this measurement can provide insight on the effects of moisture. As soon as more cells are received from CSU and UT we will continue with investigating the effects of moisture on the CdTe cell structure.

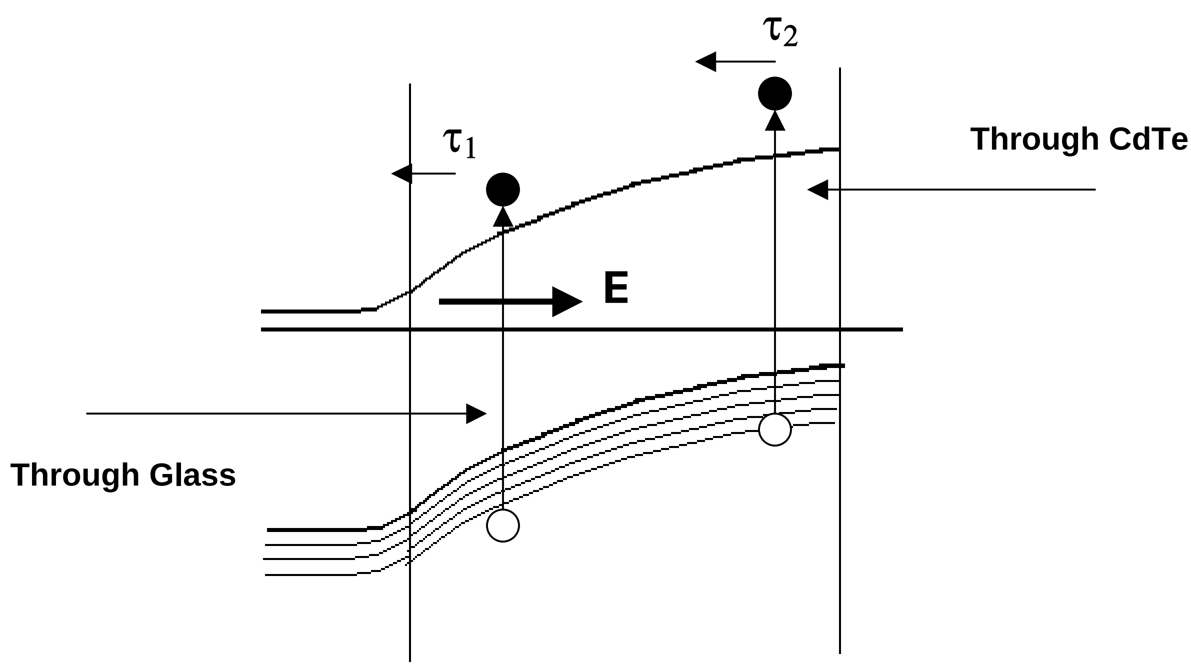

Figure 3. Electron band diagram used to interpret PL results. $\tau_1 > \tau_2$ due to effects of the electric field.